

School of Computer Science

CPS813 Final Exercise: *Plutonium Dioxide Dilemma (Ex PDD)*

Situation

A container of plutonium dioxide has been discovered at Ryerson University in the Library's "Collaboratorium".

Ryerson Security and Emergency Services (RSES) discovered the container while conducting a routine patrol within one of the interior rooms. One member of RSES team was startled when, what appeared to be, an improvised explosive device (IED) constructed from a small mousetrap was set off--spraying the member with an unknown white powder. Personnel from RSES roped off the area to restrict access to it.



Figure 2 *Improvised Explosive Device made from mousetrap*



Toronto Police Services (TPS) CBRNE response

Figure 1 *Plutonium Dioxide Container*

unit were notified by RSES and attended the scene. TPS CBRNE attempted to conduct a reconnaissance of the area using their robots but all of them malfunctioned. A hand-carried sensor sweep indicated that radiation was confined to the area where the container was first seen. TPS CBRNE has requested the assistance of the students of CPS813/DG8010 Human-Robot Interaction (HRI) to conduct a reconnaissance for TPS CBRNE. They are particularly interested in the state of the plutonium dioxide container.

Mission

CPS813 students working in their groups will use small wireless robots to explore the "search area" (miniaturized to fit on a tabletop surface) this will include:

- find, avoid or neutralize IEDs
- make a map
- indicate the location and state of the plutonium dioxide container.

The mission will be accomplished in 4 phases¹.

Phase 1. Create wireless exploration robot no larger than 10" x 10" x 10" armed with a tool that can be used to disrupt mousetrap IEDs.

Phase 2. Starting from the "Start Pad" use NCART lab Explosive Disposal Unit (EDU) Robots transport exploration robot to the search area.

Phase 3. Place exploration robot on search area surface.

Phase 4. Search the search area completing the mission

¹ Phases need not be accomplished in order

School of Computer Science
 Floor Plan

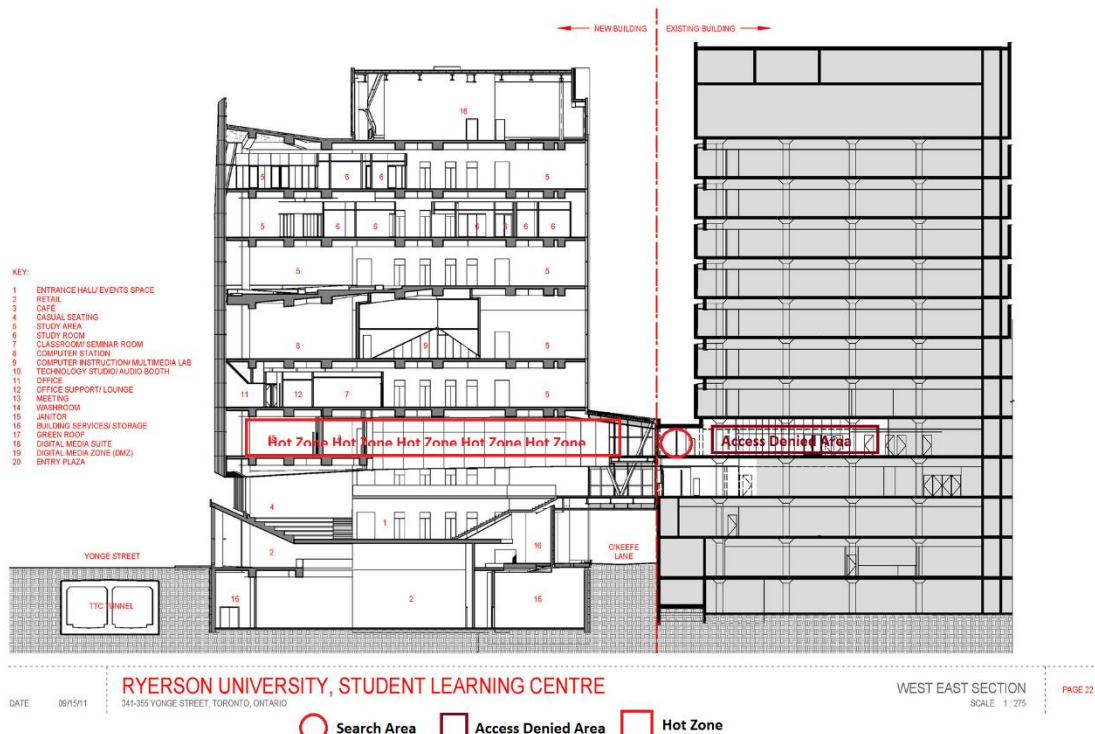


Figure 3 Student Learning Centre Floor plan indicating significant spaces

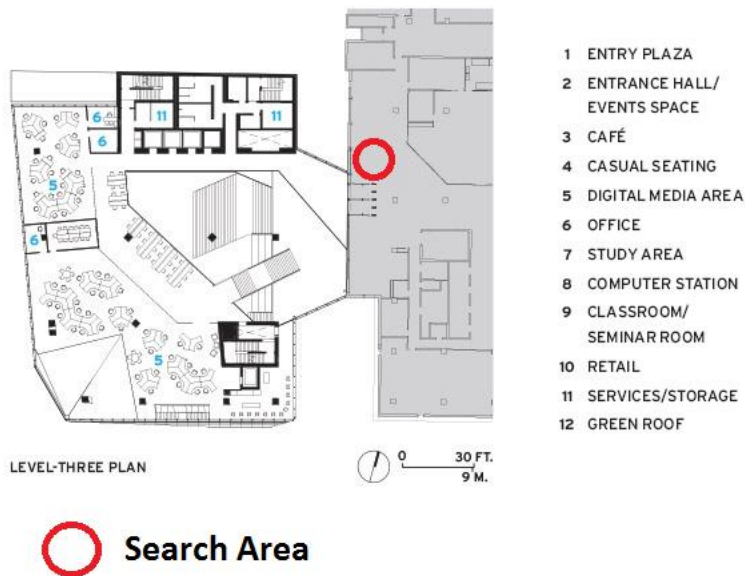


Figure 4 Student Learning Centre 3rd level floor plan indicating search area

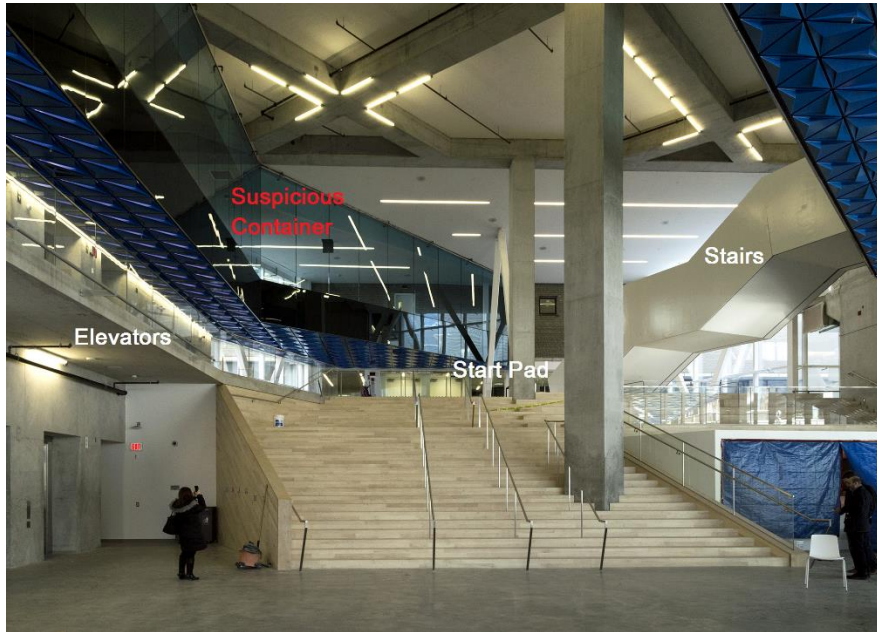


Figure 5 Photo from foyer of Student Learning Centre indicating "Start Pad"

Execution

Coordinating Instructions

- Groups will meet at the Exercise "start pad" No later than (NLT) 1500 18APR2017 where a briefing and walkthrough will be conducted.
- Groups will proceed through the phases based on their readiness and the availability of a "marker".
- End Exercise will occur NLT 1800 18APR2017

Concept of Operation

Phase 1. may be completed using the usual methodology.

Phase 2. may be completed using either stairs or an elevator to reach the search area.

Robot operators may accompany their robots but must be wearing appropriate personal protective equipment (PPE) consisting of a bomb suit with helmet if they enter the "hot zone". All buttons, etc. must be activated by the EDU robot. There is a time limit of 15 minutes to complete this Phase.

Phase 3. will be complete when the exploration robot has been placed on the search area by the EDU robot.

Phase 4. requires that a exploration robot finds at least 5 IEDs and will be complete when the map is complete and the state of the plutonium dioxide container has been determined. There is a time limit of 15 minutes to complete this Phase.

Administration and Logistics

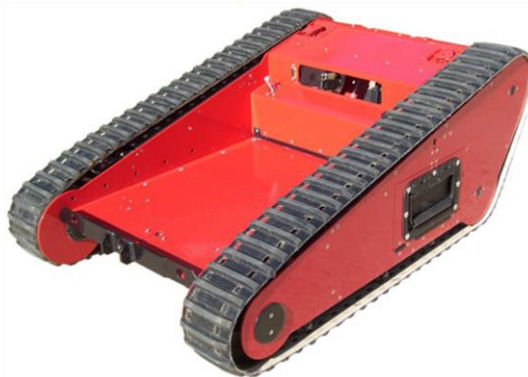
Available EDU robots are indicated in the illustrations below. EDU robots will be transported to the Student Learning Centre by N-CART staff. Familiarization training has been conducted. Refresher training is available on request. Testing of any plan to use the EDU robots with the exploration robot is highly recommended.

Vanguard “MK2” Remotely Operated Vehicle (ROV)



Telescopic and articulated arm with 6 axes of movement
 Speed:
 Weight: 115 lbs
 Ascends / descends stairs (with practice)
 Continuous rotation claw
 2 independent firing circuits
 3 standard cameras
 5+ hours operation
 Compact storage

Mesa Robotics “Element”/”Matilda (light)” Modular Robotics Platform (MRP)



Size: 21W x 12H x 30L inches (533 x 304 x 762 mm)
 Weight: 40 Lb (18 kg).
 Operating Time: 6 -10 hrs.
 Payload Area: 216 in² (1394 cm²)
 Payload Capacity: 125 Lb (57 kg).
 Towing Capacity: 225 Lb (102 kg).
 No Cameras
 No Arm
 No Controller
 Zero Turn Radius
 Climbs 50° Stairs

Pedsco (Canada) “RMI” (Remote Mobile Investigator)



Speed: 0-3 km/h forward and reverse
 Weight: 317 lbs
 Turns on own axis
 Slope - 45°- Can climb stairs (with considerable planning)
 All weather -20°C / +50°C
 Battery life - 5-6 hours typical mission
 6 wheel drive. Removable track system
 Lifting capacity: 180 lbs
 Full extension 44”
 Mount for shotgun & trigger assembly

Control

Scoring

- Marks will be assigned by Graduate Assistants.
- The exercise will be marked out of 100 points.
- Available points are indicated in the table below.

Phase	Activity and Point value	Possible Points
1	Robot is functional: 2 points Robot has disruptor tool: 2 points Disruptor tool can be operated: 2 points	6
2	EDU robot carry and release scheme: 2 points EDU robot negotiates stairs: 6 points EDU robot negotiates elevator: 6 points EDU robot reaches search area: 2 points Phase completed on time: 5 points	15
3	EDU robot places exp. robot: 3 points EDU robot releases exp. robot: 3 points Exp. robot responds to commands: 3 points	9
4	Avoid IED in path: 10 points Disrupt IED in path: 15 points Disruptor failure: -5 points IED explosion: -20 points Map quality: 10 points Plutonium Dioxide Container state indication: 10 points Phase complete on time: 5 points	Dependent on actions taken
Final	All Phases complete	Max 100